

18. Write notes on the following:
- (a) Vibrational coupling, (3)
 - (b) Overtones, (3)
 - (c) Fermi Resonance. (4)
19. (a) Propose a structure for an alcohol that has the following ^{13}C NMR spectral data:
- Broadband decoupled ^{13}C NMR – 19.0, 31.7, 69.5 δ ; DEPT 90–31.7 δ ; DEPT 135 — Positive peak @19.0, negative peak at 69.5 δ . (6)
- (b) Illustrate the NMR of AMX type molecule and the spin system of such a molecule. (4)
20. Describe the evolution of vibrational partition function for diatomic ideal gases.

NOVEMBER/DECEMBER 2025

GCH33/DCH33 — PHYSICAL
CHEMISTRY III

Time : Three hours

Maximum : 75 marks

SECTION A — (10 $\times$ 2 = 20 marks)

Answer ALL questions.

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1. Compare symmetry factor and transfer coefficient of an electrochemical reaction.
 2. Does exchange current density reflects the activity of a catalyst? - Justify your answer.
 3. Are ferromagnetism and ferroelectricity comparable? - Comment on it.
 4. Whether the photoconduction takes place by IR, visible or UV light? What about the energy levels of the excited electrons?
 5. Why do molecules behave as non-rigid rotors?
 6. Whether stokes Raman or anti-stokes Raman is more common? - Give Reason.

7. Point out the coupling constants of vinylic-cis, vinylic-trans and vinylic-gem protons.
8. Mention the number of peaks and their intensity ratio of ^{31}P NMR of $[\text{PF}_6]$.
9. Sketch the Maxwell-Boltzmann distribution curve with different temperatures and point out their shapes.
10. Give the formula of Stirling approximation. When will it be more useful.

SECTION B — ($5 \times 5 = 25$ marks)

Answer ALL questions.

11. (a) Discuss the low-field and high-field approximations of Butler-Volmer equation.

Or

- (b) Classify the types of overpotential and explain its significance.

12. (a) Explain the principle, advantages and applications of laser.

Or

- (b) Evaluate the non-stoichiometric defects in solids.

13. (a) Write a short note on the effect of solvent on UV-vis spectroscopy.

Or

- (b) Discuss the unequal spacings in pure rotational spectra.

14. (a) Discuss the phenomenon of complex coupling using methyl acrylate and their coupling constants.

Or

- (b) Write a short note on the equation of motion of spin in magnetic fields.

15. (a) Compare the different types of statistics.

Or

- (b) Comment on the distribution of distinguishable and non-distinguishable Particles.

SECTION C — ($3 \times 10 = 30$ marks)

Answer any THREE questions.

16. Give an account on Pourbaix and Evans diagrams.
17. Describe the electrical properties of solids.